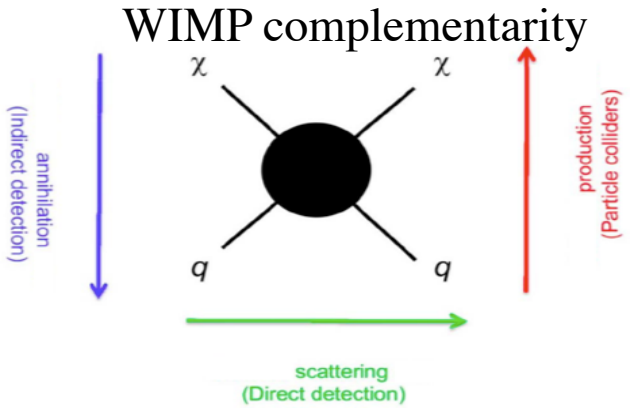
Complementarity between Cosmos and Laboratory



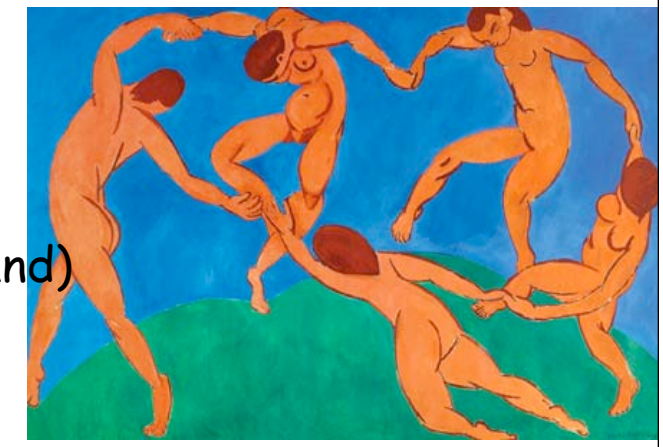
Dark Matter

LHC cannot say that missing particles are stable: Need to detect in cosmos

Direct Detection: very clean but little input on fundamental physics

Indirect Detection: smoking gun but likely to be ambiguous: will need confirmation

Dark Energy



What if w=-1? Quantum energy of vacuum

Can we detect vacuum fluctuations?

Perl-Mueller idea (atom interferometry)?

Coupling with micro machines (Schwab,Cleland)

Need theoretical work -> clever schemes

Planck Scale Physics

Hogan's interpretation of holography

Effect at scale $L \approx \sqrt{LL_P} \Rightarrow measurable$ (Holometer in progress)

Can we use quantum physics in our measurements

Squeezed light in Advanced LIGO

Quantum limited amplifiers or Rydberg atoms in axion searches

Dark energy ??

Dark Matter

WIMP: generic dark matter <->TeV scale

Not a miracle: Just a question! Does not explain (yet) why $\Omega_{DM} \approx 6\Omega_b$!

Not only possibility ! Axions

WIMP Direct Detection: Convergence of the community

Why don't you guys combine? We do not know yet the best technologies…

Sensitivity = Mass + background free.

A responsible common roadmap

Generation 1 -> 10^{-45} cm^2 Exploration of technology + science (Supersymmetry)

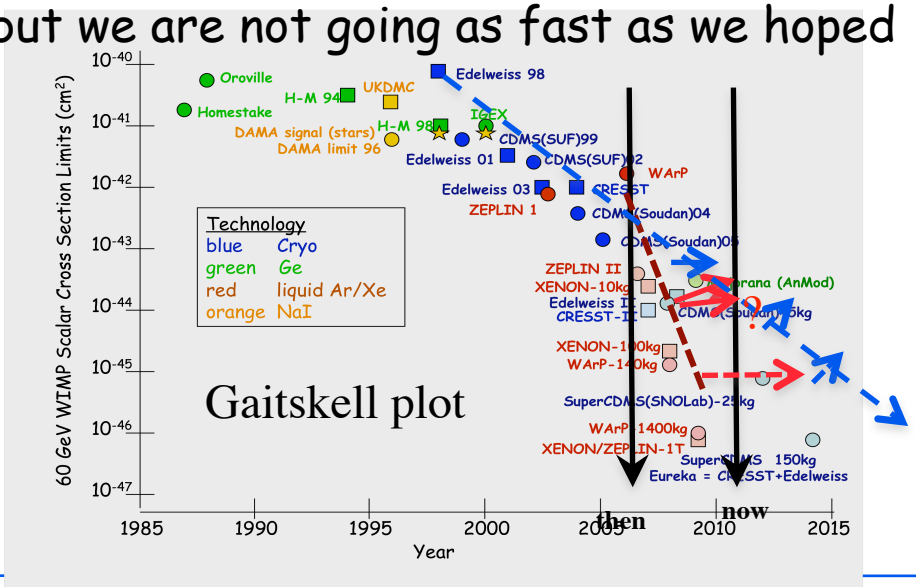
Generation 2 -> 10^{-46} cm^2 Push the most promising technologies to their limit + science

Generation 3 -> $<10^{-47}$ cm^2 2 (US) 3or4 worldwide -> detailed understanding of the physics

≈2014 technology choice

Encouraging progress

but we are not going as fast as we hoped



Time to develop technology

Realities of instrumentation

Ge: economic scaling

Xe: purity->self shielding

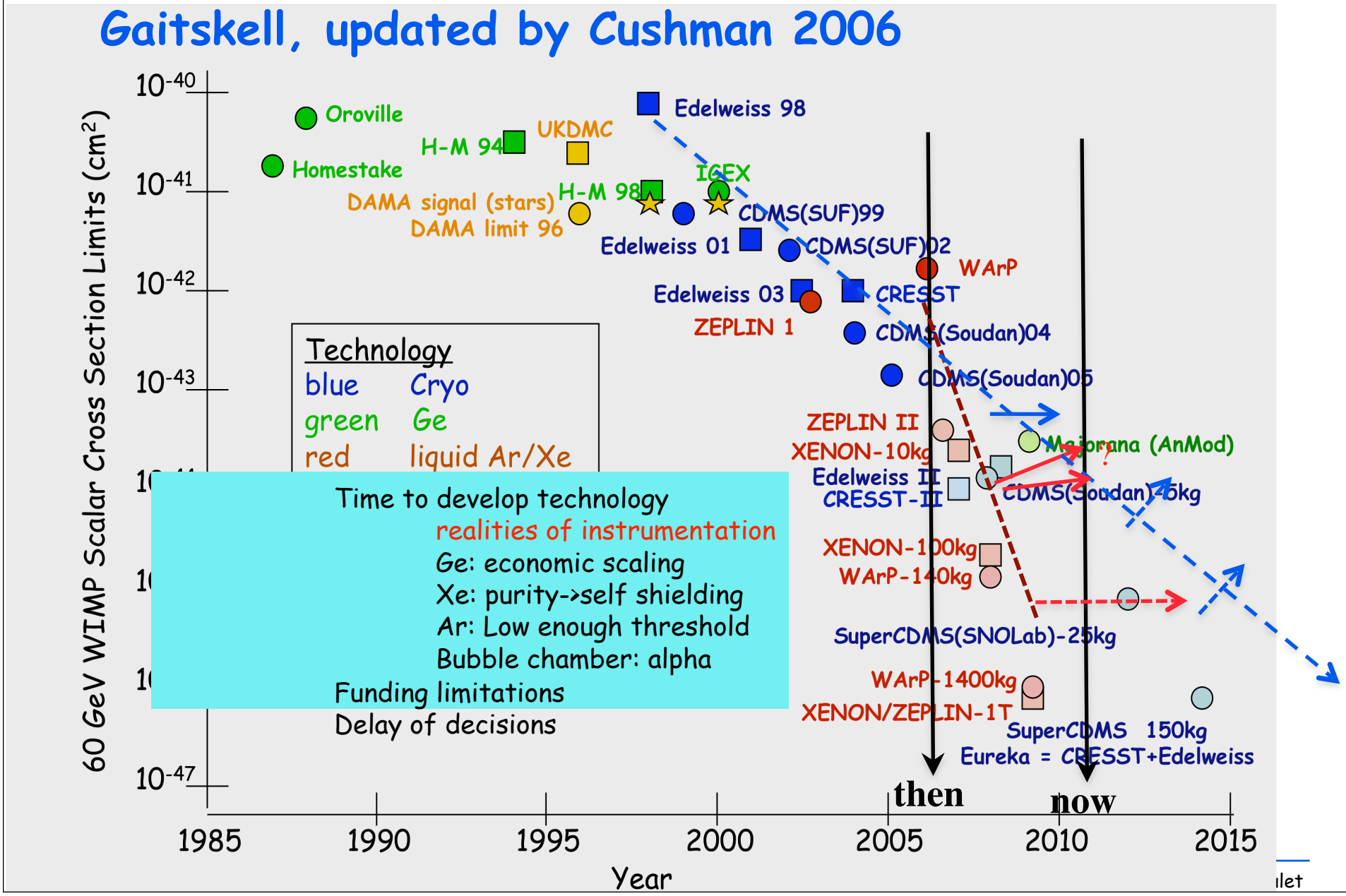
Ar: Low enough threshold

Bubble chamber: alpha

Funding limitations

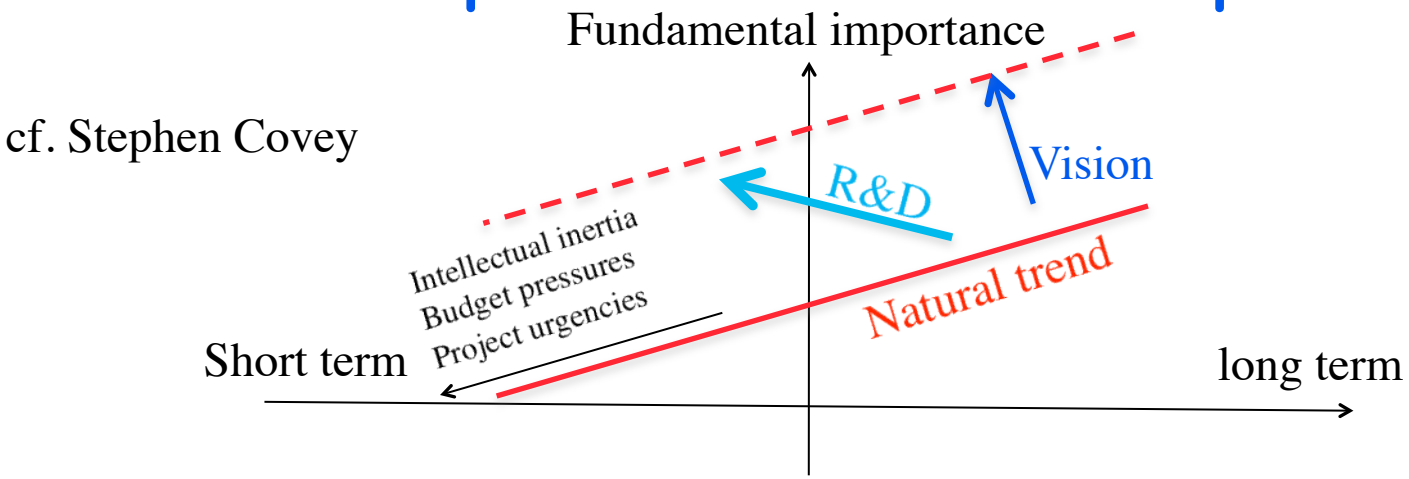
Delay of decisions

Hopes and Progress



Investment for the long term

Fundamental importance vs short term pressures



Deep Underground Science and Engineering Laboratory